**3GPP TSG RAN meeting #93e RP-21xxxx**

**Electronic Meeting, September 13-17, 2021**

## Status Report to TSG

**Agenda item:** 9.3.1.6

|  |  |
| --- | --- |
| **WI / SI Name** | NR Positioning Enhancements |
| included in this status report | Study Item: No | Core part: Yes | Performance part:Yes | Testing part:No |
| **Acronym** | NR\_pos\_enh |
| **Unique ID** | 900160 |
| **TSG Tdoc of latest approved WI/SI description (if any)** | RP-210903 |
| **Target Completion Date****(indicate if changed)** | Study Item: NA | Core part: 03/2022 | Performance part:09/2022 | Testing part: NA |
| **Overall Completion level** | Study Item: NA | Core part: 55%: | Performance Part: 0%: | Testing part:NA |

Note: Overall completion level percentage numbers should use one of the colors below:

* xx%: Normal progress, no RAN plenary action needed
* xx%: Progress behind schedule, may need RAN plenary intervention. If so, SR should clearly define requested action
* xx%: Progress critically behind, RAN plenary shall intervene. SR should define requested action

**Source:**

|  |  |
| --- | --- |
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## 1 Work plan related evaluation

|  |  |
| --- | --- |
| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | No |

*If you answered No: Then please remove the Excel file from the zip file of this status report.*

*If you answered Yes: Then please fill out the attached Excel template to request a modification of the time budgets for your WI /SI. The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI. The basis are the endorsed time budgets of the last RAN meeting. Please highlight all changes of the values.
 One time unit (TU) corresponds to ~ 2 hours in the meeting.
 If this status report covers a WI with Core and Performance part, then please have one line for each in the attached Excel table.
 Note: If no Excel table is attached, then this means no time budget change.*

**Additional explanations/motivations for the time budget changes in the attached Excel table:**

## 2. Detailed progress in RAN WGs since last TSG meeting (for all involved WGs)

 NOTE: Agreements and Open issues impacted cross-TSG aspects shall be explicitly highlighted

## 2.1 RAN1

#### 2.1.1 Agreements

**RAN1#106-e**

RAN1 has discussed topics:

* accuracy improvements by mitigating mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays;
* accuracy improvements for UL-AoA positioning solutions
* accuracy improvements for DL-AoD positioning solutions
* latency improvements for both DL and DL+UL positioning methods
* enhancements of information reporting from UE and gNB for multipath/NLOS mitigation
* others (on-demand transmission and reception of DL PRS and support positioning for UEs in RRC\_ INACTIVE state)

###### **Topic #1:** Accuracy improvements by mitigating mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays

The offline email discussion are summarized in **R1-2108245**. The following agreements were made in the topic:

Agreement:

* Subject to UE capability, support a UE to include one UE Rx TEG ID for the RSTD reference time and one UE Rx TEG ID for each DL RSTD measurement (including each additional DL RSTD measurement), in a DL TDOA measurement report. These UE Rx TEG IDs can be the same or different.
* Note: RSTD reference time is related to the DL\_PRS\_Reference\_Info IE

Agreement:

Make the following modification of the previous agreement:

For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE ~~may~~ should support, up to UE capability, either one or both of the following options:

* Option 1: Reporting of UE RxTx TEG ID ~~is supported by the UE~~
	+ FFS: Further details on how the UE RxTx TEG IDs are related/associated to UE Tx TEG IDs and/or UE Rx TEG IDs and to the UE Rx-Tx measurements.
* Option 2: Reporting of ~~UE RxTx TEG ID is not supported by the UE; reporting of~~ UE Rx TEG ID and UE Tx TEG ID ~~is supported~~.
* In either option, a UE Tx TEG ID is associated with (downselection needed)
	+ Alt. 1: an UL SRS resource for positioning corresponding to the Tx timing of the UE Rx-Tx measurement
	+ Alt. 2: the Tx timing of the UE Rx-Tx measurement
	+ Alt. 3: one or more UL SRS resources for positioning
* Note: An UE Rx TEG ID is associated with one DL PRS resource (or more DL PRS resources) corresponding to the Rx time of the measurement
* FFS: How to resolve potential mismatch between UE and gNB Rx-Tx time difference measurements (e.g. UE provides the UE Rx-Tx measurements associated with a Tx TEG with SRS1, while gNB provides the gNB Rx-Tx measurements with a Rx TEG associated with SRS2).
* FFS: The potential impact and modification on the definition of Rx-Tx time difference measurements

Agreement:

* Subject to UE capability, support the LMF to request a UE to optionally measure the same DL PRS resource of a TRP with N different UE Rx TEGs and report the corresponding multiple RSTD measurements.
	+ FFS: N=[2, 3, 4] or other values, where the maximum value of N depends on UE capability.
	+ FFS: whether the TRP can be either a “RSTD” reference TRP or a neighbor TRP
	+ FFS: details of the signalling, procedures, and UE capability
	+ FFS: The multiple RSTD measurements can share the same time stamp
	+ Note: All RSTD measurements are relative to a single reference timing
* Support the LMF to request a TRP to optionally measure the same SRS resource of a UE with M different TRP Rx TEGs and report the corresponding multiple RTOA measurements.
	+ FFS: M = [2, 3, 4] or other values
	+ FFS: details of the signalling, procedures
	+ FFS: The multiple RTOA measurements can share the same time stamp

Agreement:

* Consider supporting one of the following alternatives related to the UE Rx-Tx time difference (decision to be made in RAN1#106b):
	+ Option 1:
		- Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.
		- Add the following to the UE Rx-Tx time difference definition (similar to the definition for HD-FDD UE in TS 36.214):
			* If the UE does not transmit SRS in subframe #j, and if the UE reports an additional timestamp for the positioning SRS associated to the measurement, it shall compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS.
	+ Option 2:
		- Subject to a UE capability, a UE may optionally report Timing Adjustment (TA) change information
			* Option 3A: The TA change information is included in the UE Tx TEG report
			* Option 3B: The TA change information is included in the Rx-Tx measurement report
			* Note: TA change information corresponds to: Tx Timing change with a timestamp that this change occurred.
	+ Option 3:
		- Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.
		- Add the following to the UE Rx-Tx time difference definition (similar to the definition for HD-FDD UE in TS 36.214):
			* If the UE does not transmit SRS in subframe #j, and if the UE reports an additional timestamp for the positioning SRS associated to the measurement, it is up to UE to compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS, or include the difference (Timing Adjustment change) without compensation within the report
	+ Other options are not precluded.

Agreement:

Consider the following options (both could be selected) until RAN1#106b-e

* Option 1: Support LMF to optionally indicate the measurement time window (MTW) for a UE for the measurement instances included in a measurement report.
* Option 2: Support LMF to optionally indicate the measurement time window for a gNB for the measurement instances included in a measurement report.
* FFS: the details of the MTW configuration.
* Any requirements can be discussed by RAN4 after decision on the options is made.

Agreement:

* If a Tx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE should also report the association of the Tx TEG ID to the UL SRS resource(s)
	+ FFS: how the the association of the Tx TEG ID to the UL SRS resource(s) is determined by UE.
	+ FFS: details of the signalling

Agreement:

If a RxTx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE may optionally also report a Tx TEG ID.

###### Topic #2: Accuracy improvements for UL-AoA positioning solutions

The offline email discussion are summarized in **R1-2108291**. The following agreements were made in the topic:

Agreement:

The maximum number of UL-AOAs values (pair of AOA & ZOA values) to be reported per SRS resource for the first arrival path corresponding to the same timestamp is 8.

Conclusion:

It is up to RAN3 to decide how to support indication of UL AoA/ZoA assistance information in LCS for LCS to GCS translation

Agreement:

Further study and conclude whether association of UL-AOA, UL-TDOA, Multi-RTT measurements with ARP (Antenna Reference Point) information is supported at RAN1#106bis-e.

Agreement:

Reporting of one UL-RTOA and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning and per SRS resource for MIMO in a single gNB report to LMF is supported

* The above measurements are associated with SRS resource ID which is also reported to LMF
* FFS: Reporting of RSRP for the first arrival path
* Note: The use of SRS for MIMO resource is transparent to the UE
* FFS: Reporting of gNB Rx-Tx

Agreement:

Reporting of one gNB Rx-Tx time difference and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning in a single gNB report to LMF is supported

* The above measurements are associated with SRS resource ID which is also reported to LMF
* FFS: Reporting of RSRP for the first arrival path

###### Topic #3: Accuracy improvements for DL-AoD positioning solutions

The offline email discussion are summarized in **R1-2108623**. The following agreements were made in the topic:

Agreement:

For the beam/antenna information to be optionally provided to the LMF by the gnodeB, decide to support one of the following options:

* Option 2.1: The gNB reports quantized version of the relative Power/Angle response per PRS resource per TRP
	+ The relative power is defined with respect to the peak power of that resource
	+ FFS: How many relative power levels can be included (e.g., single -3 dB power-levels, multiple power-levels, etc).
* Option 2.2: The gNB reports quantized version of the relative Power between PRS resources per angle per TRP.
	+ The relative power is defined with respect to the peak power in each angle
	+ For each angle, at least two PRS resources are reported.
* FFS: support of multiple levels of quantization
* FFS: how the report is constructed
* FFS: overhead reduction mechanisms, including reusing of associated-dl-PRS-ID as a way of signaling that 2 TRPs have the same beam information
* The gNB beam/antenna information can optionally be provided to the UE by the LMF
* Note: Up to RAN2 & RAN3 the signaling/procedures on how the LMF receives this information from the gNBs
* Send an LS to RAN2 & RAN3 with this agreement

Agreement:

For definition of the path PRS RSRP, consider the following options until RAN1#106b-e:

* Option 1: the measured path PRS RSRP correspond to the power of the channel impulse response, at a certain path delay, over which the DL PRS is received.
* Option 2: the path PRS RSRP correspond to the accumulated power of the channel impulse response over which the DL PRS is received, over a time duration corresponding to the given path delay
	+ FFS: whether/how is the window conveyed to the UE (i.e., fixed in specification or configured in measurement request or determined by the UE)
* FFS on relationship with the UE DL PRS measurement bandwidth.
* FFS: normalization of the path RSRP measurement with DL PRS RSRP (i.e. RSRP for all path as defined in Rel-16) could be included in the measurement definition.
* FFS: Further details of the definition, e.g. definition of the certain path delay
* Up to RAN4 to define any test/requirement for the measurement.

Agreement:

* For UE-A DL-AOD, support reporting more than 8 DL PRS RSRP measurements per TRP.
* Note: Multiple RSRPs corresponding to same or different Rx Beam index should be able to be reported for a given PRS resource for different timestamps.
* FFS: Limit the maximum number of DL PRS RSRP associated with the same Rx beam index

R1-2108646 LS on beam/antenna information for DL AOD in NR positioning RAN1, Ericsson

###### **Topic #4:** Latency improvements for both DL and DL+UL positioning methods

The offline email discussion are summarized in **R1-2108583**. The following agreements were made in the topic:

Agreement:

Subject to UE capability, support LMF to explicitly request UE to report the measurement with either M-sample or 4-sample, if RAN4 has supported M-sample measurement.

* FFS signalling details.

Agreement:

For the purpose of positioning latency reduction, with potential support of a new mechanism of MG request, consider the following options with a decision to be made in RAN1#106b.

* Option. 1: by LMF (via a NRPPa message)
* Option. 2: by UE (via UCI or UL MAC CE)

Agreement:

For the purpose of positioning latency reduction, with potential support a new MG activation and deactivation procedure, consider the following options with a decision to be made in RAN1#106b (and RAN4 to be informed about any decision made)

* Option. 1: DCI
* Option. 2: DL MAC CE
* Option. 3: UE autonomously applies the MG

FFS whether deactivation can be implicit via configurable number of the MG occasions

Working assumption:

Subject to UE capability, support PRS measurement outside the MG, within a PRS processing window, and UE measurement inside the active DL BWP with PRS having the same numerology as the active DL BWP.

* Inside the PRS processing window, subject to the UE determining that DL PRS to be higher priority, support the following UE capabilities:
	+ Capability 1: PRS prioritization over all other DL signals/channels in all symbols inside the window.
		- Cap. 1A: The DL signals/channels from all DL CCs (per UE) are affected.
		- Cap. 1B: Only the DL signals/channels from a certain band/CC are affected.
			* FFS: band or CC
	+ Capability 2: PRS prioritization over other DL signals/channels only in the PRS symbols inside the window
	+ A UE shall be able to declare a PRS processing capability outside MG.
		- FFS: Details of capability signalling (e.g., per UE or per band, etc.)
* For the purpose of this feature, PRS-related conditions are expected to be specified, with the following to be down-selected:
	+ Alt. 1: Applicable to serving cell PRS only
	+ Alt. 2: Applicable to all PRS under conditions to PRS of non-serving cell.
* Note: When the UE determines higher priority for other DL signals/channels over the PRS measurement/processing, the UE is not expected to measure/process DL PRS which is applicable to all of the above capability options.
* Further study
	+ Further details of which other DL signals/channels to be prioritized
	+ How the UE determines DL PRS’s priority based on one or more of the following:
		- Opt. 1: Based on indication/configuration from serving gNB
		- Opt. 2: Other options (e.g., implicit, signalling from LMF, etc)
	+ Whether UE can do the measurement for both inside MG (if MG is configured) and outside MG in a measurement period
	+ How to do the PRS measurement when the conditions cannot be satisfied, e.g. when BWP switching happens
	+ Prioritization conditions of processing PRS over other DL channels/signals or vice versa.
* Send an LS to RAN2, RAN3 and RAN4 informing them of this working assumption and requesting feedback in case they have concerns.

R1-2108639 LS on PRS measurement outside the measurement gap RAN1 (Huawei)

###### **Topic #5:** Enhancements of information reporting from UE and gNB for multipath/NLOS mitigation

The offline email discussion are summarized in **R1-2108629**. The following agreements were made in the topic:

Agreement:

* For up to N>2 additional paths, support reporting relative timing (to the first detected path) in the measurement reports from UE to LMF for at least DL-TDOA and multi-RTT
	+ FFS: Definition of additional paths for N>2
	+ FFS: Whether power is additionally reported and if reported whether power is relative to first detected path or total power
* Support one of the following options for maximum value of N at RAN1#106-b (any further criteria for selection to be discussed during RAN1#106):
	+ Option 1: N = 4
	+ Option 2: N = 8
	+ Option 3: N = 16
	+ Option 4: N = 32

Agreement:

* For multipath reporting enhancements, support reporting from TRP to LMF, angle, timing, for up to additional N>2 paths for at least UL-TDOA and multi-RTT.
	+ FFS: Definition of additional paths for N>2
	+ FFS: Whether power is additionally reported and if reported whether power is relative to first detected path or total power
* Down select between the following options for N at RAN1#106-b (any further criteria for selection to be discussed during RAN1#106):
	+ Option 1: N = 4
	+ Option 2: N = 8
	+ Option 3: N = 16
	+ Option 4: N = 32

Agreement:

* Support LoS/NLoS indicators which are reported to the LMF for DL and DL+UL positioning measurements taken at UE for UE-assisted positioning or UL and DL+UL measurements at the TRP for NG-RAN assisted positioning.
	+ Reporting from UE is subject to UE capability
* Positioning assistance data from LMF is enhanced for UE-based positioning by including LoS/NLoS indicators.
* FFS: Other kinds of positioning assistance data enhancements
* For LoS/NLoS detection method(s), there is no additional measurement IEs or assistance data outside of LoS/NloS indicator reporting (i.e., Option 6 from prior agreement).
* Note 1: No RAN4 requirements are expected for the LoS/NLoS indicators in RAN1’s understanding
* Note 2: LoS/NLoS indicators can be complementary to outlier rejection algorithms.

Agreement:

Reporting multiple UL-AoA values per additional path is supported for at least UL TDOA and multi-RTT.

* FFS: maximum number of UL-AoA values per additional path.

Agreement:

For LoS/NLoS indicators, a single-indicator can be reported and the supported values are a discrete set in the interval [0, 1].

* FFS: the number of discrete values to be supported
* Note: This does not preclude using binary values only which is up to UE/TRP implementation
* Note: Single-indicator means that one value in the interval [0, 1] is used for the LoS/NLoS indication

###### **Topic #6:** Others (On-demand transmission and reception of DL PRS and support positioning for UEs in RRC\_ INACTIVE state)

The offline email discussion are summarized in **R1-2108294**. The following agreements were made in the topic:

Agreement:

* The following lists of on-demand DL-PRS parameters are discussed/prepared by RAN1 and provided as input to RAN2:
	+ List#1: List of parameters for UE-initiated on-demand DL PRS request
	+ List#2: List of parameters for LMF-initiated on-demand DL PRS request
* For the following lists of on-demand DL-PRS parameters, send an LS to RAN2 to check whether RAN2 would like RAN1 to send the list of parameters and request feedback as early as possible:
	+ List #3: List of parameters for UE-initiated on-demand DL PRS request associated with pre-configured set of on-demand DL PRS configurations
	+ List #4: List of parameters for LMF-initiated on-demand DL PRS request associated with pre-configured set of on-demand DL PRS configurations

R1-2108383 LS to RAN2 with update on RAN1 discussion for on-demand DL PRS

Agreement:

From RAN1 perspective, it is feasible to support transmission of SRS for positioning by UEs in RRC \_INACTIVE state for UL and DL+UL positioning under certain validation criteria

* FFS: Type(s) of SRS for positioning (i.e., periodic, semi-persistent, aperiodic)
* FFS: Details of validation criteria which may also be discussed in RAN2
* Send LS to RAN2 informing them of this agreement

Agreement:

Open loop power control defined in Rel.16 for transmission of SRS for positioning by RRC\_CONNECTED UEs is applicable for RRC\_INACTIVE UEs.

Agreement:

Spatial relation defined in Rel.16 for transmission of SRS for positioning by RRC\_CONNECTED UEs is applicable for RRC\_INACTIVE UEs.

Conclusion:

It is up to RAN2 to define TA procedures for SRS for positioning transmission by RRC\_INACTIVE UEs.

R1-2108563 Draft LS to RAN2 on SRS for Positioning Transmission by UEs in RRC\_INACTIVE State Moderator (Intel Corporation)

R1-2108564 LS to RAN2 on SRS for Positioning Transmission by UEs in RRC\_INACTIVE State RAN1, Intel Corporation

Agreement:

At least the following list of on-demand DL PRS parameters is supported for UE-initiated and LMF-initiated on-demand DL PRS requests

1. DL PRS Periodicity

2. DL PRS resource bandwidth

3. DL PRS QCL information

Conclude on remaining parameters at RAN1#106-bis-e

R1-2108509 Reply LS on determination of location estimates in local co-ordinates

#### 2.1.2 Remaining Open issues

* For accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays, there are still some major issues left such as how the UE Tx TEG information is reported to the LMF; how to handle the impact of the time adjustment on UE Rx-Tx time difference measurement, whether to introduce the measurement window, etc. Also, some details, such as the maximum numbers of Rx/Tx/RxTx TEGs, the configuration of the measurement instances, etc. are need to be resolved in the next meetings.
* For accuracy improvements for DL-AoD positioning solutions, it needs to make the final decision on what kinds of the beam/antenna information are provided to the LMF by the gNB; the definition of the path RSRP, etc.
* For latency improvements for both DL and DL+UL positioning methods, the main effort is expected to be on the completion of the work related to PRS processing window, as well as make the decision on which of the options will be adopted to support for reduce the latency.
* For enhancements of information reporting from UE and gNB for multipath/NLOS mitigation, the main effort is expected to be spent on the discussions related to the discrete values to be supported for the LoS/NLoS, and making the decision on the options and FFSs included in the agreed multipath reporting enhancements.
* For others (on-demand transmission and reception of DL PRS and support positioning for UEs in RRC\_ INACTIVE state), for supporting RAN2’s work, RAN1 needs to provide the complete lists of on-demand PRS parameters to RAN2.
* In addition, we may also need to provide the preliminary RRC parameter list and UE feature list for ePOS to RAN2/RAN3 in the next meeting.

## 2.2 RAN2

#### 2.2.1 Agreements

**RAN2#115-e**

RAN2 has discussed topics: 1) Latency; 2) RRC\_INACTIVE; 3) On-demand PRS; 4) GNSS positioning integrity, 5) A-GNSS enhancements and LSs from other groups.

**Topic #1: Latency**

Based on summary document R2-2107680 and at meeting offline discussion 612, 613, 614 , RAN2 discussed issues related to Latency reduction and agreed:

Agreement:

Agreement:

Proposal 3: Regarding the validity conditions/criteria associated with pre-configured assistance data, consider at least the following options:

 Option A: Based on a validity area (e.g. a list of cells)

 Option B: Based on a (configured) validity timer or a numerical limit on number of times it is utilized

 Option C: Based on explicit modification or release from the LMF/NG-RAN

 Option D: Based on the UE’s current location and/or the time

Agreement:

Proposal 6 (modified): In response to the question asked by SA2 regarding UE positioning capability, ~~it is proposed to~~ capture that the positioning related UE capabilities can be variable.

NOTE: P6 was edited after agreement for clarity (deletion marked with strikeout). Checked in email discussion [AT115-e][600].

Following LSs were approved:

* R2-2108958 Reply LS to SA2 on scheduled location time;
* R2-2108959 Draft reply LS on granularity of response time;
* R2-2108960 Response LS on storage of UE Positioning Capabilities

**Topic #2: RRC\_INACTIVE**

Based on post meeting email discussion R2-2108383, summary document R2-2108826 and at meeting offline discussion 615, RAN2 discussed issues related to RRC\_INACTIVE and agreed:

Agreements:

LPP PDU and LCS message transfer:

Proposal 1: The LPP PDU Transfer Procedure in Annex A is used as baseline for further work.

NOTE 1: Some details may depend on further progress of the SDT work item.

NOTE 2: Whether such a procedure needs to be captured in Stage 2 specification or not can be decided later when the procedure has been fully developed/agreed. That is, the procedure can be considered as "running baseline".

Proposal 2: The LCS Message Transfer Procedure in Annex B is used as baseline for further work.

NOTE 1: Some details may depend on further progress of the SDT work item.

NOTE 2: Whether such a procedure needs to be captured in Stage 2 specification or not can be decided later when the procedure has been fully developed/agreed. That is, the procedure can be considered as "running baseline".

Proposal 3: UL LPP message segmentation can also be used by the UE in RRC\_INACTIVE state; i.e., a LPP message body can be sent in several shorter LPP messages instead of one long LPP message by using the SDT "Subsequent Data Transmission" phase. FFS spec impact.

DL and RAT-independent positioning:

Proposal 4: The Deferred 5GC-MT-LR Procedure with SDT for DL-only and RAT-independent positioning in Annex C is used as baseline for further work.

NOTE 1: Some details may depend on further progress of SDT work item.

NOTE 2: Whether such a procedure needs to be captured in Stage 2 specification or not can be decided later when the procedure has been fully developed/agreed. That is, the procedure can be considered as "running baseline".

NOTE 3: Once the procedure is stable from RAN2 perspective, send an LS to SA2 including the baseline procedure.

Agreement:

(High priority)Proposal 1: Support all the RAT independent positioning methods in RRC\_INACTIVE state.

Agreement:

gNB can configure the UE with periodic SRS (assuming periodic SRS is supported in RRC\_INACTIVE) by RRCRelease with suspendConfig at least when periodic event is configured for deferred MT-LR. Other cases can be further discussed.

**Topic #3: On-demand PRS**

Based on post meeting email discussion R2-2108400, summary document R2-2108827 and at meeting offline discussion 618, RAN2 discussed issues related to On-demand PRS and agreed:

Agreements:

Before providing available DL-PRS configuration to the UE, the LMF may obtain configuration information on what DL-PRS can be supported from one or more TRPs via NRPPa.

Capture the steps provided above as a baseline, along with a note indicating it remains FFS if the UE can send the MO-LR to request on-demand PRS.

FFS if we indicate to SA2 that MO-LR can be used to trigger on-demand PRS procedure.

It is up to Network (LMF) implementation on the steps to follow (accept/reject/ignore) on receiving request from UE for changing the DL-PRS configurations.

Following LSs were approved:

* R2-2109123Reply LS to RAN1 on on-demand DL PRS parameters

**Topic #4: GNSS positioning integrity**

Based on post meeting email discussion R2-2107989 and summary document R2-2109029, RAN2 discussed issues related to GNSS positioning integrity and agreed:

Agreements:

Proposal 1: Agree that the GNSS feared events will be addressed in the WI.

Proposal 2 (modified): Agree that all for A-GNSS positioning methods, positioning integrity determination is supported in LPP.

Proposal 3: Agree that additional IEs are needed in LPP to support A-GNSS positioning integrity determination.

Proposal 4: The specific algorithms used for positioning integrity shall be up to implementation.

Proposal 5: For interoperability, the use of “hard-coded” parameters should be minimized and instead the needed parameters should be sent explicitly in the assistance data.

Proposal 6: RAN2 agrees that the PL will be reported in the Integrity Results. It is FFS whether Mode 2 and the TIR, AL, TTA that were used in the integrity calculation will also be reported in the integrity results.

Proposal 8: Agree that the UE feared events will be handled in the implementation for UE-based (network-assisted) methods of positioning integrity determination.

Proposal 10: Agree that the LMF feared events can be handled via implementation for the UE-based (network-assisted) and UE-assisted (LMF-based) methods of positioning integrity determination.

Proposal 11: RAN2 agrees to use Common Positioning IEs to transfer the KPIs and Integrity Results.

Proposal 12: RAN2 agrees that the LPP procedures can be used to transfer the KPIs and Integrity Results. For UE-assisted, the LCS procedures remain FFS in the case of MO-LR.

Agreements:

In Rel-17, we do not address the data transmission feared event (i.e. we rely on the system’s existing methods for assuring data integrity).

Agreements:

Proposal 1: The support of GNSS integrity is enabled by using existing NG-RAN positioning architecture.

Proposal 2: Any additional functional elements, positioning/integrity modes, etc. should be introduced only when needed.

Agreements:

Proposal 3 (modified): Separate procedures for "A-GNSS Positioning Integrity" as proposed in R2-2107503 will not be defined; the existing A-GNSS (and general location) Procedures are applicable/sufficient.

Proposal 4 (modified): RAN2 confirms that LPP messages RequestLocationInformation and ProvideLocationInformation are used to transfer integrity KPIs/results, respectively, for GNSS positioning at least for UE-based mode.

Proposal 5 (modified): RAN2 confirms that LPP messages RequestAssistanceData and ProvideAssistanceData are used to transfer integrity assistance data for GNSS positioning at least for UE-based mode.

**Topic #5: A-GNSS enhancements**

RAN2 had short discussion on this topic, and concluded that CRs can be updated for next meeting;

**Topic #6: LS on PRU**

RAN2 discussed RAN1 LS PRU and related issues via at meeting offline discussion R2-2108940, and agreed:

Agreements:

Proposal 1 (modified): For purposes of RAN2 discussion, the PRU functionality as described in the RAN1 LS can be considered as UE with known location (to some degree of accuracy) at least (16/17).

PRU modelled as a gNB can be discussed in RAN3 (no RAN2 action).

Agreement:

RAN2 confirm that the PRU considered as a UE supports the normal LPP procedures for assistance data transfer and location information transfer.

#### 2.2.2 Remaining Open issues

* Latency reduction:
	+ Scheduled location time: whether scheduled location time needs to be transmitted to UE and NG-RAN;
	+ Storing positioning capability in AMF; FFS on RAN impact;
	+ Details on pre-configured assistance data, e.g. Solution on validity conditions/criteria associated with preconfigured assistance data; (will be handled via post meeting email discussion 605)
	+ Stage 2 CR; (will be handled via post meeting email discussion 605 and 609)
	+ Stage 3 work;
* RRC\_INACTIVE:
	+ Details on positioning in RRC\_INACTIVE, e.g. SRS , and enhancements on assistance information, etc; (PRS configuration/measurement enhancements will be handled via post meeting email discussion 608)
	+ Stage 2 CR; (will be handled via post meeting email discussion 609)
	+ Stage 3 work;
* On-demand PRS
	+ Details on, e.g. trigger criterion for UE initiated case, the content of on-demand PRS request, support of MO-LR, etc; (MO-LR for on demand PRS will be handled via post meeting email discussion 606)
	+ Need RAN1 inputs on parameters details;
	+ Stage 2 CR; (will be handled via post meeting email discussion 609)
	+ Stage 3 work;
* GNSS positioning integrity:
	+ Details of assistance information, the signalled KPIs and reporting of the integrity results (assistance data will be handled via post meeting email discussion 607)
	+ Stage 2 CR; (will be handled via post meeting email discussion 614)
	+ Stage 3 work;
* A-GNSS positioning enhancements;
	+ Stage 3 work on how to capture BDS B2a signal, BDS B3I signal and NavIC;
* Support of RAN1/ RAN3/ RAN4 work;
	+ To support the work led by other working groups;
	+ PRU, identification of PRU and impact on RAN2/SA2

## 2.3 RAN3

#### 2.3.1 Agreements

**RAN3#113-e**

RAN3 has discussed the following topics: 1) Positioning Accuracy Improvements, 2) RRC\_INACTIVE State Positioning, 3) On-Demand PRS Transmission and Reception, 4) Support for Latency Improvement and 5) LSs from other groups.

**Topic #1: Positioning Accuracy Improvements**

Based on summary documents R3-214200 and R3-214309 regrouping the offline e-mail discussions, RAN3 discussed issues related to Positioning Accuracy Improvements and made the following agreements:

Agreement:

* Define a new Assistance Information for UL-AoA IE with the Expected AoA/ZoA values and their Uncertainties using a CHOICE structure. Stage 3 details are FFS
* Agree to introduce the UL-AoA assistance information in NRPPA MEASUREMENT REQUEST message, within the TRP Measurement Request List IE
* Agree to introduce the UL-AoA assistance information in NRPPA MEASUREMENT UPDATE message, within a new TRP Measurement Update List IE (FFS)
* Agree to introduce a Zenith Angle of Arrival IE to the TRP Measurement Result IE. Adding description for linear array FFS. FFS if LMF can request the Zenith Angle of Arrival only.
* No indication from gNB to LMF is needed for requesting the Expected UL AoA.
* Maintain the F1AP BL CR up to date with respect to NRPPa progress. Companies are encouraged to check the BL CR and to converge to an agreement for next meeting.
* **The following text proposal for TS 38.455 BL CR was agreed:** [**R3-214297**](file:///C%3A%5CUsers%5Ceangcen%5CAppData%5CLocal%5CTemp%5CTemp1_RAN3_113-e_agenda_20210819_1835.zip%5CInbox%5CR3-214287.zip) **(Ericsson,** **Huawei, Nokia, Nokia Shanghai Bell, CATT, ZTE, Qualcomm Inc.)**

**Topic #2: RRC\_INACTIVE State Positioning**

Based on summary document in R3-214201 regrouping the offline e-mail discussion, RAN3 discussed issues related to RRC\_INACTIVE State Positioning and no agreement was taken.

**Topic #3: On-Demand PRS Transmission and Reception**

Based on summary document in R3-214202 regrouping the offline e-mail discussion, RAN3 discussed issues related to On-Demand PRS Transmission and Reception and made the following agreements:

Agreement:

* Enhance the TRP Information Exchange procedure to support pre-defined PRS configurations.
* No need to support explicit indication of TRP capabilities in NRPPa.
* Wait for convergence in RAN2 before tackling any Stage 2 aspects in RAN3 (if any)
* **The following text proposal for TS 38.455 BL CR was agreed:** [**R3-21428**](file:///C%3A%5CUsers%5Ceangcen%5CAppData%5CLocal%5CTemp%5CTemp1_RAN3_113-e_agenda_20210819_1835.zip%5CInbox%5CR3-214287.zip)**6 (Nokia, Nokia Shanghai Bell, Ericsson, Huawei, Qualcomm, ZTE)**

**Topic #4: Support for Latency Improvement**

Based on summary documents in R3-214203 and R3-214310 regrouping the offline e-mail discussions, RAN3 discussed issues related to Support for Latency Improvement and made the following agreements:

Agreement:

* Introducing a Response Time in NRPPa Measurement Request message
* **The following text proposal for TS 38.455 BL CR was agreed: R3-214300 (Huawei)**

**Topic #5: LS from other groups**

Positioning Reference Unit:

* Based on e-mail discussion in R3-214142, RAN3 discussed the LS from RAN1 on Positioning Reference Units (PRUs) and **agreed to sending a reply LS in R3-214457**.

Location estimates:

* Based on e-mail discussion in R3-214143, RAN3 discussed the LS from SA2 on determination of location estimates in local co-ordinates and **agreed to sending a reply LS in R3-214312**.

## 2.4 RAN4

#### 2.4.1 Agreements

***RAN4#100-e***

RAN4 has discussed topics: 1) General and RRM requirements impacts 2) Latency reduction 3) Impact on existing UE positioning and RRM requirements 4) UE Rx/Tx and/or gNB Rx/Tx timing delay mitigation 5) Measurement in RRC\_INACTIVE state 6) Enhancements of A-GNSS positioning and LSs from other groups.

**Topic 1: General and RRM requirements impacts**

On demand PRS

 *Wait for agreements in other WGs*

*FFS: RRM requirements impact due to on-demand PRS*

Requirements for first path PRS-RSRP

*Wait for RAN1 outcome*

*FFS: Requirements for first path PRS-RSRP and their feasibility*

RRM requirements impact due to enhancement of information reporting for multipath/NLOS mitigation

 *No requirements impact due to enhancement of information reporting for multipath/NLOS mitigation*

**Topic 2: Latency reduction**

Processing sample reduction

*Reduction of DL PRS processing samples is possible under certain conditions*

*Low latency enhancement*

* + *It is RAN4 understanding that the reduction of the number of DL PRS processing samples is possible under certain conditions*
		- *In some cases, the reduction of the number of DL PRS processing samples is feasible under assumption of relaxation of the Rel-16 NR positioning accuracy requirements for the existing side conditions (e.g. SINR, PRS configurations, channel models, etc.)*
		- *In some cases, the reduction of the number of DL PRS processing samples is feasible under assumption of keeping Rel-16 NR positioning accuracy requirements and for the case of using different side conditions (e.g. SINR, PRS configurations, channel models, etc.)*
	+ *For Rel-17, low latency NR Positioning requirements definition the goal is to meet the existing Rel-16 NR positioning accuracy requirements*
		- *FFS whether to consider limited relaxations of requirements for specific scenarios*
* *RAN4 to revisit AGC margins in the context of latency reduction*
* *RAN4 to study under which circumstances additional sample or no additional sample needs to be considered for AGC margin when the number of samples only is 1 or 2.*
* *Further study the impact of reducing number of processing samples*
	+ *Number of processing PRS samples: 1, 2, 3, 4 (reference/R16 assumption)*
	+ *PRS BW: FFS*
	+ *SNR conditions:*
		- *Option 1: Rel-16 side condition*
		- *Option 2: Higher SNR side conditions than in Rel-16*
	+ *Channel models:*
		- *Option 1: Rel-16 channel models*
		- *Option 2: LOS channel models (e.g. TDL-D, TDL-E)*

*Note: other parameters and options are not precluded*

Reduced number of DL PRS processing samples based on different measurements PRS-RSRP, PRS-RSTD and UE Rx-Tx?

*FFS based on outcome of study on reducing PRS processing samples*

Reduction of number of samples?

*FFS, since dependency on other issues*

*FFS feasibility of M = 1 sample*

Indication of number of samples to be expected?

*FFS based on other WG outcome and RAN4 outcome regarding reduced PRS processing samples framework/requirements*

Define a set of enhanced measurement accuracy requirements based on sample reduction?

*FFS based on outcome of study on reducing PRS processing samples*

Measurement gaps

*Wait for RAN1 conclusions before discussing gapless PRS measurement requirements*

Revise PRS measurement period requirement in Rel-17 for low-latency NR positioning measurements in relation to measurement gaps?

*FFS revision can be discussed based on conclusions of latency reduction methods*

Measurement period

*RAN4 to consider measurement period optimizations related to T\_last for positioning frequency layers in which all PRS resources are contained within a single measurement gap instance per T\_(available\_PRS”,” i)*

*FFS the details of such measurement period optimizations*

*FFS measurement latency optimizations by reducing N(RxBeam,i) for NR positioning measurements in FR2*

Following LS was approved:

**R4-2115366 Reply LS on PRS processing samples**

**Topic 3: Impact on existing UE positioning and RRM requirements**

SRS antenna switching

*FFS: the impact of SRS antenna port switching impact on UE Rx-Tx measurement*

*FFS: solution depends on the impact*

*FFS: the impact of SRS antenna port switching impact on gNB Rx-Tx measurement and ULRTOA*

*FFS: solution depends on the impact*

**Topic 4: UE Rx/Tx and/or gNB Rx/Tx timing delay mitigation**

*Common understanding: TEG framework enables association information without limiting implementation to ensure that the timing error difference between measurements/transmissions associated to the same TEG are within a certain margin.*

*It is not necessary to know the absolute timing error for UE Rx/Tx TEG.*

*Confirm that the timing error mitigation mechanism defined by RAN1 is feasible for both UE Rx/Tx and gNB Rx/Tx.*

*UE/TRP may group the timing errors for UE/TRP Rx/Tx (e.g., based on RF chains and antenna panel) such that timing error difference in the same group is within a certain margin*

*FFS on RRM requirements for timing error mitigation mechanism, timing error grouping method, criteria and margin. FFS if any specific UE behavior will be defined.*

*RAN4 discussion is based on that TEG is applicable for both TRP and UE.*

Following LS was approved:

**R4-2115368 Reply LS on gNB/UE Rx/Tx timing error mitigation**

**Topic 5: Measurement in RRC\_INACTIVE state**

*At least UE RRM requirements for DL RSTD and DL PRS-RSRP measurements in RRC-INACTIVE state are specified.*

*RAN4 shall define inactive state positioning measurements for FR1 and FR2.*

*MG is not to be considered in the measurement period requirements in RRC\_INACTIVE state.*

*Use the framework or formula of Rel-16 PRS\_RSRP measurement period as a baseline to derive the inactive state PRS-RSRP measurement period.*

*Use the framework or formula of Rel-16 RSTD measurement period as a baseline to derive the inactive state RSTD measurement period.*

*FFS: RAN4 to take connected mode measurement performance requirements for DL RSTD and PRS-RSRP as baseline for inactive state measurement performance requirements.*

*RAN4 wait for the outcomes of other WGs and define the reporting requirements based on the conclusions.*

*RAN4 to discuss impact of positioning measurements on RRC INACTIVE state functions.*

**Topic 6:** **Enhancements of A-GNSS positioning**

*It is not needed to update TS 36.171, 37.171 and 38.171 to release 17 at this stage.*

*RAN4 define requirements for additional BDS signals and NavIC after RAN2 has introduced the signaling support.*

## 2.5 RAN5

#### 2.5.1 Agreements

#### 2.5.2 Remaining Open issues

#### 2.5.3 Remaining Open issues with cross-WG dependencies

## 2.6 RAN6

#### 2.6.1 Agreements

#### 2.6.2 Remaining Open issues

## 3. Detailed progress in SA/CT WGs since last TSG meeting (for all involved WGs)

NOTE: This section only needs to be filled in for WI/SIs where there is a corresponding relevant WI/SI in SA/CT.

## 3.1 SAx/CTs

#### 3.1.1 Agreements with cross-TSG impacts

#### 3.1.2 Remaining Open issues with cross-TSG impacts

NOTE: This section should also flag any critical dependencies that need TSG attention.

## 4. References

NOTE: This can be e.g. a list of all related Tdocs in the affected WGs since last TSG, references to LSs, produced TRs/TSs, the work/study item description or status reports of previous TSGs.

1. R1-2106449 Enhancement to mitigate gNB and UE Rx/Tx timing error Huawei, HiSilicon
2. R1-2106450 Enhancement for UL AoA positioning Huawei, HiSilicon
3. R1-2106451 Enhancement for DL AoD positioning Huawei, HiSilicon
4. R1-2106452 Positioning latency enhancements Huawei, HiSilicon
5. R1-2106453 Enhancements to support multi-path and NLOS mitigation Huawei, HiSilicon
6. R1-2106549 Positioning accuracy improvement by mitigating timing delay ZTE
7. R1-2106550 Accuracy improvement for UL-AoA positioning solutions ZTE
8. R1-2106551 Accuracy improvement for DL-AoD positioning solutions ZTE
9. R1-2106552 Discussion on latency reduction for NR positioning ZTE
10. R1-2106553 Enhancements on NLOS and Multi-path mitigation for NR positioning ZTE
11. R1-2106554 Discussion on items led by RAN2 for NR positioning ZTE
12. R1-2106595 Discussion on potential enhancements for RX/TX timing delay mitigating vivo
13. R1-2106596 Discussion on potential enhancements for UL-AoA method vivo
14. R1-2106597 Discussion on potential enhancements for DL-AoD method vivo
15. R1-2106598 Discussion on latency enhancement for NR positioning vivo
16. R1-2106599 Discussion on potential enhancements for multipath/NLOS mitigation vivo
17. R1-2106600 Discussion on inactive state positioning and on-demand PRS vivo
18. R1-2106809 On mitigating Rx/Tx timing delays Sony
19. R1-2106810 Considerations on UL-AoA enhancements Sony
20. R1-2106811 Considerations on DL-AoD enhancements Sony
21. R1-2106812 Considerations on latency improvements for positioning Sony
22. R1-2106813 Discussion on enhanced reporting for multipath/NLOS mitigation Sony
23. R1-2106814 Considerations on positioning in RRC Inactive and on-demand PRS Sony
24. R1-2106888 Discussion on accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays Samsung
25. R1-2106889 Discussion on accuracy improvements for UL-AoA positioning solutions Samsung
26. R1-2106890 Discussion on accuracy improvements for DL-AoD positioning solutions Samsung
27. R1-2106891 Discussion on latency improvements for both DL and DL+UL positioning methods Samsung
28. R1-2106892 Discussion on potential enhancements of information reporting from UE and gNB for multipath/NLOS mitigation Samsung
29. R1-2106893 Discussion on demand positioning and positioning in inactive state Samsung
30. R1-2106971 Discussion on mitigating UE and gNB Rx/Tx timing errors CATT
31. R1-2106972 Discussion on enhancements for UL-AoA positioning method CATT
32. R1-2106973 Discussion on enhancements for DL-AoD positioning method CATT
33. R1-2106974 Discussion on latency reduction for NR positioning CATT
34. R1-2106975 Discussion on information reporting from UE and gNB for multipath/NLOS mitigation CATT
35. R1-2106976 Discussion on on-demand DL PRS and positioning for UEs in RRC\_ INACTIVE state CATT
36. R1-2107057 Views on mitigating UE and gNB Rx/Tx timing errors Nokia, Nokia Shanghai Bell
37. R1-2107058 Views on enhancing UL AoA Nokia, Nokia Shanghai Bell
38. R1-2107059 Views on enhancing DL AoD Nokia, Nokia Shanghai Bell
39. R1-2107060 Views on PHY Latency Reductions Nokia, Nokia Shanghai Bell
40. R1-2107061 Views on LoS/NLoS Identification and Mitigation Nokia, Nokia Shanghai Bell
41. R1-2107062 Additional views on Inactive Mode Positioning and on-demand PRS Nokia, Nokia Shanghai Bell
42. R1-2107096 NLOS Mitigation Enhancements FUTUREWEI
43. R1-2107134 Discussion on latency improvements for positioning methods China Telecom
44. R1-2107135 Discussion on multipath/NLOS identification and mitigation for positioning enhancement China Telecom
45. R1-2107169 Discussion on enhancements for DL-AoD positioning CAICT
46. R1-2107170 Discussion on other enhancements for on-demand PRS and INACTIVE mode positioning CAICT
47. R1-2107213 Enhancement of timing-based positioning by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays OPPO
48. R1-2107214 Enhancements for UL AoA Positioning OPPO
49. R1-2107215 Enhancements for DL-AoD positioning OPPO
50. R1-2107216 Enhancements on Latency Reduction in NR Positioning OPPO
51. R1-2107217 Discussion on multipath/NLOS mitigation for NR positioning OPPO
52. R1-2107218 Discussion on positioning for UE in RRC\_INACTIVE and on-demand PRS OPPO
53. R1-2107345 Enhancements on Timing Error Mitigations for improved Accuracy Qualcomm Incorporated
54. R1-2107346 Potential Enhancements on UL-AOA positioning Qualcomm Incorporated
55. R1-2107347 Potential Enhancements on DL-AoD positioning Qualcomm Incorporated
56. R1-2107348 Enhancements for Latency Improvements for Positioning Qualcomm Incorporated
57. R1-2107349 Multipath Reporting in NR Positioning Qualcomm Incorporated
58. R1-2107350 Enhancements Related to On Demand PRS And Positioning in RRC Inactive State Qualcomm Incorporated
59. R1-2107403 Discussion on mitigation of gNB/UE Rx/Tx timing errors CMCC
60. R1-2107404 Discussion on UL-AoA enhancements CMCC
61. R1-2107405 Discussion on DL-AoD enhancements CMCC
62. R1-2107406 Discussion on latency improvement for positioning CMCC
63. R1-2107407 Discussion on RAN2-led items for positioning CMCC
64. R1-2107542 Discussion on accuracy improvement by mitigating UE Rx/Tx and gNB Rx/Tx timing delays LG Electronics
65. R1-2107543 Discussion on accuracy improvement for UL-AoA positioning LG Electronics
66. R1-2107544 Discussion on accuracy improvement for DL-AoD positioning LG Electronics
67. R1-2107545 Discussion on latency improvements for NR positioning LG Electronics
68. R1-2107546 Discussion on multipath/NLOS mitigation for positioning LG Electronics
69. R1-2107590 Details of UE/gNB RX/TX Timing Errors Mitigation Intel Corporation
70. R1-2107591 Remaining Details of NR Positioning UL-AoA Enhancements Intel Corporation
71. R1-2107592 DL-AoD Enhancements for Precise NR Positioning Intel Corporation
72. R1-2107593 Latency Reduction Solutions for NR Positioning Intel Corporation
73. R1-2107594 Solutions for Mitigation of NLOS Problem for NR Positioning Intel Corporation
74. R1-2107595 On-demand DL PRS Signalling and NR Positioning for UEs in RRC-INACTIVE state Intel Corporation
75. R1-2107643 Discussion on accuracy improvements by mitigating timing delays InterDigital, Inc.
76. R1-2107645 Discussion on enhancements for UL-AoA positioning solutions InterDigital, Inc.
77. R1-2107646 Discussion on enhancements for DL-AoD positioning solutions InterDigital, Inc.
78. R1-2107647 Discussion on latency improvements for DL and DL+UL positioning methods InterDigital, Inc.
79. R1-2107648 Discussion on multipath/NLOS mitigation for positioning InterDigital, Inc.
80. R1-2107649 Discussion on on-demand PRS and INACTIVE mode positioning InterDigital, Inc.
81. R1-2107664 Discussion on RAN2 led objectives for NR positioning Huawei, HiSilicon
82. R1-2107740 Positioning accuracy enhancements under timing errors Apple
83. R1-2107741 Positioning Accuracy enhancements for UL-AoA Apple
84. R1-2107742 Positioning Accuracy enhancements for DL-AoD Apple
85. R1-2107743 Views on Rel-17 positioning latency reduction Apple
86. R1-2107744 Views on potential enhancements for NLOS mitigation in Rel-17 positioning Apple
87. R1-2107822 Mitigation of RX/TX timing delays for higher accuracy MediaTek Inc.
88. R1-2107823 Accuracy enhancement for DL-AOD technique MediaTek Inc.
89. R1-2107828 Aspects of physical latency improvement MediaTek Inc.
90. R1-2107830 Potential physical layer impact to the RAN2-led topics MediaTek Inc.
91. R1-2107831 Discussion on other enhancements for positioning LG Electronics
92. R1-2107858 Discussion on mitigating UE and gNB Rx/Tx timing delays NTT DOCOMO, INC.
93. R1-2107859 Discussion on UL-AoA positioning enhancements NTT DOCOMO, INC.
94. R1-2107860 Discussion on DL-AoD positioning enhancements NTT DOCOMO, INC.
95. R1-2107861 Discussion on latency improvements for both DL and DL+UL positioning methods NTT DOCOMO, INC.
96. R1-2107862 Discussion on multipath/NLOS mitigation for NR positioning NTT DOCOMO, INC.
97. R1-2107863 Discussion on positioning for UEs in RRC\_INACTIVE state NTT DOCOMO, INC.
98. R1-2107922 Accuracy improvements for DL-AoD positioning solutions Xiaomi
99. R1-2107923 Latency improvements for both DL and DL+UL positioning method Xiaomi
100. R1-2107924 Potential enhancements for multipath/NLOS mitigation Xiaomi
101. R1-2107925 On-demand PRS and positioning for in-active state UE Xiaomi
102. R1-2108101 On methods for Rx/Tx timing delays mitigation Fraunhofer IIS, Fraunhofer HHI
103. R1-2108102 UL-AoA positioning enhancements Fraunhofer IIS, Fraunhofer HHI
104. R1-2108103 DL-AoD positioning enhancements Fraunhofer IIS, Fraunhofer HHI
105. R1-2108104 Potential positioning enhancements for multipath/NLOS mitigation Fraunhofer IIS, Fraunhofer HHI
106. R1-2108105 Considerations on SRS transmission for positioning in RRC\_INACTIVE state Fraunhofer IIS, Fraunhofer HHI
107. R1-2108142 Enhancements for mitigation of Tx/Rx Delays Lenovo, Motorola Mobility
108. R1-2108143 Discussion on DL-AoD Positioning Enhancements Lenovo, Motorola Mobility
109. R1-2108144 Positioning Latency Reduction Enhancements Lenovo, Motorola Mobility
110. R1-2108145 Accuracy enhancements based on NLOS/Multipath Information Reporting Lenovo, Motorola Mobility
111. R1-2108146 Discussion on On-Demand PRS and RRC\_INACTIVE Positioning Lenovo, Motorola Mobility
112. R1-2108164 Techniques mitigating Rx/Tx timing delays Ericsson
113. R1-2108165 Enhancements of UL-AoA positioning solutions Ericsson
114. R1-2108166 Enhancements of DL-AoD positioning solutions Ericsson
115. R1-2108167 Latency improvements for both DL and DL+UL positioning methods Ericsson
116. R1-2108168 Potential enhancements of information reporting from UE and gNB for multipath/NLOS mitigation Ericsson
117. R1-2108169 On-demand transmission and reception of DL PRS for DL and DL+UL positioning Ericsson
118. R1-2108174 Discussion on enhancements for DL-AoD positioning CEWiT
119. R1-2108175 Discussion on enhancements of multipath/NLOS reporting from UE and gNB CEWiT
120. R1-2108176 Discussion on enhancements for UL AoA positioning CEWiT
121. R1-2108241 FL Summary for accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays Moderator (CATT)
122. R1-2108242 FL Summary #2 for accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays Moderator (CATT)
123. R1-2108243 FL Summary #3 for accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays Moderator (CATT)
124. R1-2108244 FL Summary #4 for accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays Moderator (CATT)
125. R1-2108245 FL Summary #5 for accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays Moderator (CATT)
126. R1-2108248 FL summary #1 of 8.5.4 latency improvements for DL and DL+UL methods Moderator (Huawei)
127. R1-2108249 FL summary #2 of 8.5.4 latency improvements for DL and DL+UL methods Moderator (Huawei)
128. R1-2108250 FL summary #3 of 8.5.4 latency improvements for DL and DL+UL methods Moderator (Huawei)
129. R1-2108280 Feature Lead Summary #1 for Potential multipath/NLOS mitigation Moderator (Nokia)
130. R1-2108281 Feature Lead Summary #2 for Potential multipath/NLOS mitigation Moderator (Nokia)
131. R1-2108282 Feature Lead Summary #3 for Potential multipath/NLOS mitigation Moderator (Nokia)
132. R1-2108289 Feature Lead Summary#1 for E-mail Discussion [106-e-NR-ePos-02] Moderator (Intel Corporation)
133. R1-2108290 Feature Lead Summary#2 for E-mail Discussion [106-e-NR-ePos-02] Moderator (Intel Corporation)
134. R1-2108291 Feature Lead Summary#3 for E-mail Discussion [106-e-NR-ePos-02] Moderator (Intel Corporation)
135. R1-2108292 Feature Lead Summary#1 for E-mail Discussion [106-e-NR-ePos-06] Moderator (Intel Corporation)
136. R1-2108293 Feature Lead Summary#2 for E-mail Discussion [106-e-NR-ePos-06] Moderator (Intel Corporation)
137. R1-2108294 Feature Lead Summary#3 for E-mail Discussion [106-e-NR-ePos-06] Moderator (Intel Corporation)
138. R1-2108311 FL summary #1 for AI 8.5.3 Accuracy improvements for DL-AoD positioning solutions Moderator (Ericsson)
139. R1-2108382 Draft LS to RAN2 with update on RAN1 discussion for on-demand DL PRS Moderator (Intel Corporation)
140. R1-2108383 LS to RAN2 with update on RAN1 discussion for on-demand DL PRS RAN1, Intel Corporation
141. R1-2108507 FL summary #2 for AI 8.5.3 Accuracy improvements for DL-AoD positioning solutions Moderator (Ericsson)
142. R1-2108508 Draft reply LS on determination of location estimates in local co-ordinates Moderator (Ericsson)
143. R1-2108509 Reply LS on determination of location estimates in local co-ordinates RAN1, Ericsson
144. R1-2108563 Draft LS to RAN2 on SRS for Positioning Transmission by UEs in RRC\_INACTIVE State Moderator (Intel Corporation)
145. R1-2108564 LS to RAN2 on SRS for Positioning Transmission by UEs in RRC\_INACTIVE State RAN1, Intel Corporation
146. R1-2108577 FL summary #3 for AI 8.5.3 Accuracy improvements for DL-AoD positioning solutions Moderator (Ericsson)
147. R1-2108583 FL summary #4 of 8.5.4 latency improvements for DL and DL+UL methods Moderator (Huawei)
148. R1-2108605 Session notes for 8.5 (NR Positioning Enhancements) Ad-Hoc Chair (Ericsson)
149. R1-2108623 FL summary #4 for AI 8.5.3 Accuracy improvements for DL-AoD positioning solutions Moderator (Ericsson)
150. R2-2106913 LS on support of UL-AOA/ZOA assistance information signalling for NR positioning (R1-2106202; contact: Intel) RAN1
151. R2-2106918 Reply LS to SA2 on Scheduling Location in Advance (R1-2106312; contact: Qualcomm) RAN1
152. R2-2106919 LS on granularity of response time (R1-2106316; contact: Huawei) RAN1
153. R2-2106920 LS on Positioning Reference Units (PRUs) for enhancing positioning performance (R1-2106326; contact: CATT) RAN1
154. R2-2107132 Discussion on Response LS on Scheduling Location in Advance to reduce Latency from SA2 CATT
155. R2-2107133 Draft Response LS to SA2 on the scheduled location time CATT
156. R2-2107134 Discussion on Enhancements for Latency Reduction CATT
157. R2-2107135 Discussion on storage of UE Positioning Capabilities LS from SA2 and the granularity of response time LS from RAN1 CATT
158. R2-2107136 Discussion on Integrity KPIs impact and draft LS CATT
159. R2-2107137 Summary of Introduction of B3I signal in BDS system CATT, CAICT
160. R2-2107138 Introduction of B2a and B3I signal in BDS system in A-GNSS CATT, CAICT
161. R2-2107139 Introduction of B2a and B3I signal in BDS system in A-GNSS CATT, CAICT
162. R2-2107140 Introduction of B2a signal in BDS system in A-GNSS CATT, CAICT
163. R2-2107141 Introduction of B3I signal in BDS system in A-GNSS CATT, CAICT
164. R2-2107142 Discussion on Positioning for UEs in RRC\_INACTIVE state CATT
165. R2-2107143 Discussion on Positioning Reference Units (PRUs) for positioning enhancement CATT
166. R2-2107144 Draft Response LS to RAN1 on the Positioning Reference Units (PRUs) for positioning enhancement CATT
167. R2-2107398 Discussion on supporting positioing integrity in RAN OPPO
168. R2-2107399 Further consideration of positioning latency enhancements OPPO
169. R2-2107498 Discussion on on-demand PRS Huawei, HiSilicon
170. R2-2107499 Discussion on positioning integrity Huawei, HiSilicon
171. R2-2107500 Discussion on positioning latency Huawei, HiSilicon
172. R2-2107501 Discussion on positioning enhancement Huawei, HiSilicon
173. R2-2107502 [DRAFT] LS on positioning for the UE in RRC\_INACTIVE Huawei, HiSilicon
174. R2-2107503 Text Proposal for GNSS integrity Huawei, HiSilicon
175. R2-2107638 Remaining issues of On-Demand PRS Apple
176. R2-2107639 Positioning procedures in RRC\_INACTIVE (stage-2) Apple
177. R2-2107641 Discussion on latency enhancement vivo
178. R2-2107642 Discussion on Scheduling Location in Advance to reduce Latency vivo
179. R2-2107643 Enhancement of DL positioning in RRC\_INACTIVE vivo
180. R2-2107644 Configuration of UL positioning in RRC\_INACTIVE vivo
181. R2-2107645 Discussion on on-demand PRS vivo
182. R2-2107646 Discussion on signalling and procedures for GNSS positioning integrity vivo
183. R2-2107647 Discussion on support for Positioning Reference Unit vivo
184. R2-2107670 Scheduled location time based latency reduction Intel Corporation
185. R2-2107671 Support of Positioning in RRC\_INACTIVE Intel Corporation
186. R2-2107672 Support of on-demand PRS request Intel Corporation
187. R2-2107673 Storing UE positioning capability in AMF Intel Corporation
188. R2-2107674 Consideration on stage 2 structure on RAT dependent positioning Intel Corporation
189. R2-2107680 "Summary of agenda 8.11.2 Latency enhancements" Intel Corporation
190. R2-2107681 Discussion on Enhancements for Latency Reduction InterDigital, Inc.
191. R2-2107683 Discussion on Positioning in RRC INACTIVE state InterDigital, Inc.
192. R2-2107684 Discussion on reporting of Positioning Information with SDT InterDigital, Inc.
193. R2-2107686 Discussion on procedures for On-demand PRS for DL-based positioning InterDigital, Inc.
194. R2-2107687 Discussion on procedure for On-demand PRS for DL+UL based positioning InterDigital, Inc.
195. R2-2107688 Discussion on procedures and signalling for GNSS positioning integrity InterDigital, Inc.
196. R2-2107689 Discussion on supporting Positioning Reference Units InterDigital, Inc.
197. R2-2107828 Discussion on on-demand DL-PRS OPPO
198. R2-2107829 Supporting positioning in RRC\_INACTIVE state OPPO
199. R2-2107830 Discussion on UL Positioning methods in RRC\_INACTIVE state OPPO
200. R2-2107831 Discussion on the Positioning Reference Units (PRUs) OPPO
201. R2-2108024 Positioning Integrity Support in LPP Nokia, Nokia Shanghai Bell
202. R2-2108068 Considerations on positioning RRC Inactive Sony
203. R2-2108069 Considerations on positioning PRS On-demand Sony
204. R2-2108340 Bounding GNSS errors for positioning integrity ESA, Nokia, Nokia Shanghai Bell
205. R2-2108376 [draft] Response LS on Scheduling Location in Advance to reduce Latency Qualcomm Incorporated
206. R2-2108536 Discussion on latency reduction for positioning CMCC
207. R2-2108605 Way-forward for RRC\_INACTIVE positioning Huawei, China Unicom, China Telecom, Futurewei, HiSilicon, Intel Corporation, Interdigital, Spreadtrum Communications, VIVO, Xiaomi, ZTE Corporation
208. R2-2108703 Considerations on positioning in RRC\_INACTIVE Nokia, Nokia Shanghai Bell
209. R2-2108704 Enhancement to reduce latency for high volume positioning Nokia, Nokia Shanghai Bell
210. R2-2108705 NR E-CID for UE feedback for on-demand PRS Nokia, Nokia Shanghai Bell
211. R2-2108764 Considerations on Positioning in RRC\_INACTIVE state CMCC
212. R2-2108769 Handling of multiple QoS for latency reduction Samsung Electronics
213. R2-2108770 Consideration on the signalling design for Positioning Integrity Samsung Electronics
214. R2-2108771 Latency reduction via configured grant for positioning Samsung Electronics
215. R2-2108772 On message segmentation for transmitting in Inactive state Samsung Electronics
216. R2-2108773 Discussion on the scheduled location time Samsung Electronics
217. R2-2108774 Multiple QoS class using on-demand PRS Samsung Electronics
218. R2-2108827 Summary of Agenda Item 8.11.4 On-demand PRS CATT
219. R2-2108940 [AT115-e][610][POS] PRUs (CATT) CATT
220. R2-2108941 [Draft] LS to SA2 on network management of UE-typed PRUs CATT
221. R2-2108942 [Draft] Reply LS on determination of location estimates in local co-ordinates Ericsson
222. R2-2108943 Draft Reply LS to SA2 on scheduled location time CATT
223. R2-2108944 Draft reply LS on granularity of response time Huawei, HiSilicon
224. R2-2108945 [draft] Response LS on storage of UE Positioning Capabilities Qualcomm
225. R2-2108950 Draft Reply LS to RAN1 on on-demand DL PRS parameters Intel
226. R2-2108957 Reply LS on determination of location estimates in local co-ordinates RAN2
227. R2-2108958 Reply LS to SA2 on scheduled location time RAN2
228. R2-2108959 Reply LS on granularity of response time RAN2
229. R2-2108960 Response LS on storage of UE Positioning Capabilities RAN2
230. R2-2109029 Summary on agenda item 8.11.5 on GNSS positioning integrity Qualcomm Incorporated
231. R2-2109061 LS to RAN2 with update on RAN1 discussion for on-demand DL PRS (R1-2108383; contact: Intel) RAN1
232. R2-2109123 Reply LS to RAN1 on on-demand DL PRS parameters RAN2
233. R2-2109126 [AT115-e][612][POS] Reply LS to SA2 on scheduled location time (CATT) CATT
234. R3-213107 LS on support of UL-AOA/ZOA assistance information signalling for NR positioning RAN1, Intel Corporation
235. R3-213119 LS on On-demand PRS RAN2
236. R3-213164 Introduction of NR Positioning enhancements to NRPPa Ericsson
237. R3-213398 Scheduling Location in Advance to Reduce Latency Qualcomm Incorporated
238. R3-213445 (TP for NR\_pos\_enh BL CR for TS 38.455) UL-AOA/ZOA assistance information Nokia, Nokia Shanghai Bell
239. R3-213446 (TP for NR\_pos\_enh BL CR for TS 38.455) Pre-defined PRS configurations for on-demand PRS Nokia, Nokia Shanghai Bell
240. R3-213612 [Draft] reply LS on on-demand PRS Huawei
241. R3-213613 Discussion on support of UL-AOA/ZOA assistance information signalling for NR positioning Huawei
242. R3-213614 (TP for POS BL CR for TS 38.455): Support of UL-AOA/ZOA assistance information signalling for NR positioning Huawei
243. R3-213615 Support of UL-AOA/ZOA assistance information signalling for NR positioning Huawei
244. R3-213616 [Draft] reply LS on support of UL-AOAZOA assistance information signalling for NR positioning Huawei
245. R3-213617 Introduction of NR Positioning enhancements to F1AP Huawei
246. R3-213618 (TP for POS BL CR for TS 38.455): Positioning enhancement Huawei
247. R3-213619 Positioning enhancement Huawei
248. R3-213620 (TP for POS BL CR for TS 38.455): Discussion on RRC inactive positioning Huawei
249. R3-213621 (TP for POS BL CR for TS 38.455, TS 38.473): On-demand PRS Huawei
250. R3-213622 (TP for POS BL CR for TS 38.455, TS 38.473): Latency improvement in positioning Huawei
251. R3-213673 Support of UL-AOAZOA Assistance Information Signalling CATT
252. R3-213674 CR for 38.473 on Positioning Accuracy Improvements CATT
253. R3-213675 Positioning for UEs in RRC\_INACTIVE state CATT
254. R3-213676 Further Consideration on On-Demand PRS Procedure CATT
255. R3-213677 Further Consideration on Positioning Latency Improvement CATT
256. R3-213761 Dicussion on the Positioning Accuracy Improvements ZTE Corporation
257. R3-213762 TP for TS38.455 on Positioning Accuracy Imporvements ZTE Corporation
258. R3-213764 TP for TS38.455 on On-Demand PRS ZTE Corporation
259. R3-213842 Overview and Discussion of the received positioning liaisons Ericsson
260. R3-213851 Discussion on Rel-17 UL AoA enhancements with TP to NRPPa BL CR Ericsson
261. R3-213852 TP to F1AP BL CR for Rel-17 UL AoA enhancements Ericsson
262. R3-213853 Discussion on support of RRC-Inactive Positioning Ericsson
263. R3-213854 TP to NRPPa BL CR: Addition of On-demand DL-PRS information Ericsson
264. R3-213855 TP to F1AP BL CR: Addition of On-demand DL-PRS information Ericsson
265. R3-213856 Discussion on latency improvements for Rel-17 positioning Ericsson
266. R3-213970 Positioning in RRC inactive state Samsung
267. R3-213971 Positioning latency improvement Samsung
268. R3-214200 CB: # 1901\_Pos\_AccEnhs\_AoA-AoZ\_LS - Summary of email discussion Ericsson - moderator
269. R3-214201 CB: # 1902\_Pos\_RRC\_INACTIVE - Summary of email discussion Huawei - moderator
270. R3-214202 CB: # 1903\_Pos\_OnDemandPRS - Summary of email discussion Nokia - moderator
271. R3-214203 CB: # 1904\_Pos\_LatencyImprovement - Summary of email discussion Qualcomm - moderator
272. R3-214286 (TP for NR\_pos\_enh BL CR for TS 38.455) Pre-defined PRS configurations for on-demand PRS Nokia, Nokia Shanghai Bell
273. R3-214287 Discussion on Rel-17 UL AoA enhancements with TP to NRPPa BL CR Ericsson, Huawei, Nokia, Nokia Shanghai Bell, CATT, ZTE
274. R3-214296 Introduction of NR Positioning enhancements to F1AP Huawei
275. R3-214297 Discussion on Rel-17 UL AoA enhancements with TP to NRPPa BL CR Ericsson, Huawei, Nokia, Nokia Shanghai Bell, CATT, ZTE
276. R3-214300 (TP for POS BL CR for TS 38.455): Latency improvement in positioning Huawei
277. R3-214301 (TP for POS BL CR for TS 38.473): Latency improvement in positioning Huawei
278. R3-214309 CB: # 1901\_Pos\_AccEnhs\_AoA-AoZ\_LS - Summary of email discussion Ericsson - moderator
279. R3-214310 CB: # 1904\_Pos\_LatencyImprovement - Summary of email discussion Qualcomm - moderator
280. R3-214439 Introduction of NR Positioning enhancements to F1AP Huawei
281. R3-214486 BL CR to 38.473 Huawei
282. R3-214516 Introduction of NR Positioning enhancements to NRPPa EricssonR4-2112549 Reply LS on PRS processing samples vivo
283. R4-2111999 Discssion on PRS processing samples CATT
284. R4-2112550 Further discussion on general RRM requirements impacts for positioning enhancement vivo
285. R4-2112000 Discussion on UE Rx/Tx and/or gNB Rx/Tx timing delay mitigation CATT
286. R4-2112551 Discussion on timing delay mitigation vivo
287. R4-2112598 Discussion on UE Rx/Tx and/or gNB Rx/Tx timing delay mitigation Nokia, Nokia Shanghai Bell
288. R4-2113157 Discussion on timing delay mitigating for NR positioning enhancement Intel Corporation
289. R4-2113874 UE Rx/Tx and gNB Rx/Tx timing delay mitigation ZTE Corporation
290. R4-2114051 Reply LS on on UE/TRP Tx/Rx Timing Errors Ericsson
291. R4-2114198 On UE Rx/Tx timing error mitigation Qualcomm Incorporated
292. R4-2114310 Discussion on timing error mitigation for positioning Huawei, HiSilicon
293. R4-2112001 Discussion on latency reduction of positioning measurement CATT
294. R4-2112508 Discussion on latency reduction of positioning measurement CMCC
295. R4-2112552 Discussion on latency reduction of positioning measurement vivo
296. R4-2112599 Discussion on latency reduction of positioning measurement Nokia, Nokia Shanghai Bell
297. R4-2113158 Discussion on latency reduction for NR positioning enhancement Intel Corporation
298. R4-2113876 On latency reduction of positioning measurement ZTE Corporation
299. R4-2114052 Reply LS on PRS processing samples Ericsson
300. R4-2114199 On latency reduction of NR positioning measurements Qualcomm Incorporated
301. R4-2114311 Discussion on latency reduction for positioning Huawei, HiSilicon
302. R4-2112002 Discussion on measurement in RRC\_INACTIVE state CATT
303. R4-2112553 Discussion on measurement in RRC\_INACTIVE state vivo
304. R4-2112600 Discussion on measurement in RRC\_INACTIVE state Nokia, Nokia Shanghai Bell
305. R4-2113877 Positioning measurements in RRC\_INACTIVE state ZTE Corporation
306. R4-2114053 On positioning in RRC\_inactive Ericsson
307. R4-2114312 Discussion on PRS measurement in RRC\_INACTIVE Huawei, HiSilicon
308. R4-2112554 Discussion on impact to existing UE positioning and RRM requirements vivo
309. R4-2113880 Impact on existing UE positioning and RRM requirements ZTE Corporation
310. R4-2114313 Discussion on new MGP for positioning Huawei, HiSilicon
311. R4-2114462 Impact on RRM and positioning requirements Ericsson
312. R4-2112003 Discussion on enhancements of A-GNSS positioning CATT
313. R4-2113873 On A-GNSS positioning enhancement ZTE Corporation
314. R4-2114314 Discussion on A-GNSS enhancement in Rel-17 positioning Huawei, HiSilicon

 28.01.2021 minor adaptations for RAN #91e

 09.11.2020 minor adaptations for RAN #90e

 31.08.2020 minor adaptations for RAN #89e

 20.04.2020 minor adaptations for RAN #88e

 18.02.2020 minor adaptations for RAN #87e

 14.11.2019 minor adaptations for RAN #86

 18.08.2019 minor adaptations for RAN #85

 12.05.2019 minor adaptations for RAN #84

 27.02.2019 minor adaptations for RAN #83

 21.11.2018 completion levels with colours added (for RAN #82)

v04.81 31.07.2018 simplification of template and addition of cross-TSG aspects (for RAN #81)

v04.80 21.05.2018 minor adaptations for RAN #80

v04.79 26.02.2018 minor adaptations for RAN #79

v04.78 18.11.2017 minor adaptations for RAN #78

v04.77 06.08.2017 minor adaptations for RAN #77

v04.76 15.05.2017 minor adaptations for RAN #76

v04.75 31.01.2017 minor adaptations for RAN #75

v04.74 28.10.2016 minor adaptations for RAN #74

v04.73 01.09.2016 adaptations for RAN #73 (time units in extra Excel table, RAN6 reporting included)

v04.72 26.05.2016 adaptations for RAN #72 (introduction of NR & GERAN TUs)

v04.71 10.02.2016 minor adaptations for RAN #71

v04.70 30.10.2015 minor adaptations for RAN #70

v04.69 12.08.2015 minor adaptations for RAN #69

v04.68 21.05.2015 minor adaptations for RAN #68

v04.67 01.02.2015 minor adaptations for RAN #67

v04.66 16.11.2014 minor adaptations for RAN #66

v04.65 16.08.2014 minor adaptations for RAN #65

v04.64 22.05.2014 minor adaptations for RAN #64

v04.63 24.01.2014 restructuring for RAN #63 to cover Core & Perf. in one doc file

v03.62 11.11.2013 section 1.2.3 adapted for RAN #62

v03 11.08.2013 section 1.2.3 added on time budget

v02 07.05.2010 history added, some spelling corrections

v01 13.11.2009 First version of the template